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ABSTRACT

This report presents data collected in a teacher survey concerning the Primary Science Syllabus used in the primary schools of Queensland, Australia. Data were gathered by a single questionnaire from 259 primary science teachers randomly selected from the Brisbane South Education Region. The instrument was divided into two parts. Part I consisted of questions concerning school and teacher characteristics while Part II was concerned with the perceived adequacy of the syllabus and its implementation. Along with descriptive data about the schools and teachers involved, frequency distributions are provided for each question in the instrument. Factor analysis, cluster analysis, and discriminant analysis are used to provide information on teaching patterns and on patterns where assistance was required for the syllabus implementation. (MH)

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SCIENCE IN THE PRIMARY SCHOOL

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December 1975

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INTRODUCTION

In 1966 a major change in the teaching of science in primary schools was attempted with the introduction of a new syllabus.[1] This syllabus replaced a course in Nature Study which, with minor revisions in 1952, had been in existence since 1946. An alternative involving a variety of agricultural pursuits as its focus was accepted by many schools, mainly country, for grades 5 and beyond. The *Nature Study* courses were quite traditional in form. References to the appropriate use of "object lessons" and "school gardening" were to be found as suggestions for teaching. The Agricultural Project Club activities were as the name implies, based on the "project method". Suggestions for teaching were presented in the Handbook [2] giving an outline of philosophy and teaching methods, examples and suggestions. An advisory service for schools involved in Agricultural Project Club Activities has been in existance for many years.

With the introduction of the new Science Syllabus in 1966 Agricultural Project Club Activities remained an alternative. The orientation of these activities changed somewhat to incorporate a wider range of experiences designed to elicit the kinds of basic understandings outlined in the new Science Syllabus.

The 1966 Science syllabus incorporated the view that each discipline has both syntax and substance. In the introduction to the syllabus it was emphasised that Science was basically a "way of learning" and should be presented as a process whereby new knowledge is uncovered; the activities and experiments are not ends in themselves but are the tools of discovery. The substantive component was organized about the central theme, "Man's Environment". Around this theme five Units or Organizing centres were clustered. These comprised Living Things, Conservation, The Earth in Space, The Surface of Earth, and Energy. (The introduction of the last two was delayed until the fourth year of Primary School). Within each Organizing centre for each grade level a set of key understandings were identified. Associated with each set of understandings a suggested activity was outlined to help teachers with the mediating process. Thus, while an activity oriented syllabus, the structure was such that children could be introduced to Science primarily as a way of thinking about and gaining understanding of the environment which surrounds them.

The aims of the new syllabus were as follows:

To stimulate and develop the natural curiosity and interest of the child in the world around him.
To provide children with a variety of learning experiences designed to develop the skills and attitudes involved in using the methods of science to reach new knowledge.
To help children to organize and expand their knowledge about the natural world by developing an understanding of the generalizations of science.
To create a sense of responsibility for the conservation of natural resources.
To develop an understanding of the essential nature of science and appreciation of its romance, power, limitations, and impact on our way of life.

[1] Department of Education, Queensland. The Syllabus or Course of Instruction in Primary School Science, 1966.
[2] Department of Education, Queensland. Handbook – Agricultural Project Club Work in Queensland Schools, 1947

The main implications of these aims for teaching science was an emphasis on observation and skill. The development of an ability to see, analyse and define problems; to plan experiments; to collect, organize and interpret data; to generalize; to think critically and to evaluate data, were all seen to be important.

Through experiences it was intended that children would gain some insight into the importance of sufficient evidence and suspended judgement, critical observation and the distinction between what is believed and what can be verified. For teachers this implies structuring experiences closely attuned to the childrens' interests and intellectual competence. For this reason the syllabus contained, in an appendix, examples of a discovery teaching approach together with some implications of the concrete and formal-operations developmental stages of Piagetian theory for the teaching of primary school children.

To support the implementation of the new syllabus books, materials and equipment were supplied to schools. Workshops and seminars, conducted mainly by Inspectors of schools throughout the state, were made available to teachers.

In 1972, seven years after the implementation of the new syllabus the Primary Science Syllabus Committee was reconstituted by the Primary Curriculum Committee to advise that committee on desirable curriculum changes in Science to which attention might be given. It was to obtain some information on the current status of Science teaching in primary schools that this study seeking the views of teachers was undertaken late in 1973. Only one educational region selected. This insured that a sample, representative of teachers in various types of school settings was obtained and at the same time kept the sample size manageable. The main weakness of this approach, lack of ability to make qualified state-wide generalizations, is more than offset by the high within-region representativeness, the relatively efficient administration of the study, and the reasonably high probability that, on many issues, regional differences can be neglected. Given that teachers' views, while very important, are not the only data source but nonetheless an important one, and the fact that the study was not intended to be a complete full scale evaluation, replication across regions was not considered.

Purpose

The purpose of the survey was to obtain information from teachers of primary science with reference to:

1. The context in which science teaching occurs i.e. characteristics of teachers and schools.
2. The perceived adequacy of the present syllabus.
3. Perceptions of how the syllabus was being implemented.

Decisions regarding the specific information required from teachers were made in consultation with the Primary Curriculum Committee and the Primary Science Syllabus Committee.

Sampling

To provide reliable information on a State wide basis, a sample of at least 3000 teachers was required. In view of the size of such a study, it was decided to confine sampling to a single educational region only.

A random sample of 300 teachers, including the principals of one and two teacher schools was drawn from the Brisbane South Education Region.

This sample, which constituted one third of the population in the Region, provides reliable information for that region. However, generalization to other regions throughout the State should be undertaken with some caution since it is possible that inter-regional differences exist.

Instrumentation

Data were gathered by a single questionnaire (see Appendix 1) to each of the 300 teachers in the sample. This instrument was divided into two parts. Part 1 consisted of questions concerning school and teacher characteristics while Part II was concerned with the perceived adequacy of the present syllabus and its implementation.

259 teachers returned completed questionnaires. This respresents a highly satisfactory response rate of 86.3 percent.

Analysis

Most of the analysis undertaken comprised frequency distribution statistics for each question. In some cases however cross-plots were undertaken to provide more detailed information. For example a frequency distribution of respondents' answers to the question concerning the size of the school in which they were teaching and to a second question concerning the location of the school does not provide information on how many teachers were teaching in a one-teacher school in the metropolitan area. A two-way cross-plot of school size by location does provide this information. Actual tables associated with this example are shown in Tables 1, 2 and 3 in the Results section. More complex cross-plots were also undertaken. One of these shows frequency distributions for three variables. In this example the amount of teacher college science education, partitioned on the amount of secondary school science is cross-plotted with amount of university science training. This provides information on say, the number of respondents with one or more senior science subjects at university as opposed to a similar group who had only one year of teachers college experience. Two cells of Table 10 are the basis of the above example.

Whereas frequency distributions and cross-plots of various kinds were used as the basis for reporting many of the results of the questionnaire, more sophisticated techniques of Factor Analysis, Cluster Analysis, and Discriminant Analysis were used to provide information on teaching patterns and key patterns where assistance and/or change was required.

Thus the kinds of analysis used can be divided into two main parts. One kind, distribution statistics including frequency distributions, and cross-plots was used as a means of basic description. The first section (Section 1) of the Results is based on this form of analysis. The second kind of analysis which involved the more complex statistical procedures was used for Sections 2 and 3 of the Results. Section 2 deals with teaching strategies and Section 3 deals with needs for assistance and change.

Reporting Results

Within Section 1 of the Results, the first part is concerned with the context in which science is taught. Frequency distributions and some cross-plots are presented under the following headings:

1. Sample characteristics i.e. school size, location and grade representation.
2. School and classroom characteristics i.e. organisations, teacher deployment and special features.
3. Teacher characteristics i.e. science qualifications, age, experience and interest in science and scientific activities.

The second part is concerned with the perceptions of the syllabus and its implementation. Frequency distributions and some cross-plots are presented under the following headings:

1. Teaching and preparation time.
2. The degree to which teachers follow the syllabus.
3. The adequacy of time allocation and the importance of science in the primary school.
4. The effectiveness of teaching and attainment of syllabus aims.
5. The extent to which various teaching strategies are used.
6. Differences among topic areas in the syllabus in terms of interest, teaching difficulty and availability of resource materials.
7. Apparatus and resource material supply and availability.
8. The importance of various kinds of assistance and change.

In Section 2 of the Results the use of the various teaching strategies is further investigated. Six principal components based on the 31 items describing the teaching strategies were isolated.

Teachers were then grouped in relation to the six principal components. Five such groups emerged and the profiles of each group were defined by each group's mean on each of the principal components. The profile means, together with a graphical representation of the five groups, are presented.

In Section 3 further analysis of the teachers' reported needs for assistance was undertaken. Three groups of teachers were isolated and their profiles presented.

RESULTS

SECTION 1: Descriptive Analysis

Context in Which Science is Taught

1. *Sample Characteristics*

The distribution of teachers in terms of school size and location was examined.

TABLE 1: DISTRIBUTION OF TEACHERS IN VARIOUS SCHOOLS BY SIZE AND LOCATION

Size of School – No. of Teachers	LOCATION						TOTAL
	Number Not Responding	Metropolitan	Provincial City	Provincial Town	Small Town or District	Other	
1					3 (1.2)		3 (1.2)
2					2 (0.8)		2 (0.8)
3		4 (1.5)					4 (1.5)
4–10		21 (8.1)	1 (0.4)	1 (0.4)	9 (3.5)		32 (12.4)
11–20		56 (21.6)	12 (4.6)	2 (0.8)	8 (3.1)	2 (0.8)	80 (30.9)
Above 20	1 (0.4)	97 (37.5)	23 (8.9)	9 (3.5)	3 (1.2)	5 (1.9)	138 (53.3)
TOTAL	1 (0.4)	178 (68.7)	36 (13.9)	12 (4.6)	25 (9.7)	7 (2.7)	259 (100)

Note: Numbers in brackets represent approximate percentage of total.

Table 1 indicates that the majority of teachers in the region sampled, taught in large schools. Most taught in schools located in the metropolitan area or a provincial city. In fact 37.5% of the sample taught in metropolitan schools with more than 20 teachers on staff while only 1.2% of teachers taught in one-teacher schools in a small town or district. This kind of distribution is to be expected when teachers within a region is the unit sampled. Comparisons of the sample properties with the total regional characteristics, indicated the sample to be unbiased with respect to the particular region sampled.

The sample characteristics of the region selected for study should be clearly kept in mind when interpreting the findings of this survey. This is particularly important since the representation of small schools in the State as a whole is much greater than is indicated in this sample (308 one-teacher schools out of a total of 1059 schools).

2. *School and Classroom Characteristics*

Tables 2 to 9 provide some indication of the context in which science teaching takes place.

TABLE 2: DISTRIBUTION OF TEACHERS BY GRADE LEVEL TEACHING

Grade Level	Numbers of Teachers	Percent (Approx.)
Grade 1	35	14
Grade 2	36	14
Grade 3	31	12
Grade 4	28	11
Grade 5	33	13
Grade 6	31	12
Grade 7	42	16
Composite lower schools	8	3
Composite upper schools	12	4
One-teacher schools	3	1
	259	100

The grade distribution of teachers was approximately equal. Very few teachers were teaching composite grades.

TABLE 3: DESCRIPTION OF KIND OF CLASSROOM

Kind of Classroom	Number of Teachers	Percent (Approx.)
Self-contained	218	84
Multiple Area	32	12
Other	9	4
	259	100

The majority of classrooms are of a traditional self-contained kind while some were described by the teachers as multiple area.

TABLE 4: DESCRIPTION OF PROCEDURE FOR ASSIGNING CHILDREN TO CLASS

Method	Number of Teachers	Percent (Approx.)
On basis of ability	21	8
Heterogeneously	226	88
Other	10	4
	257	100

Note: Total less than 259 due to 2 non-responses.

The majority of classes were not composed of children grouped on the basis of ability. Heterogeneous grouping was by far the most common form of assigning children to classes.

TABLE 5: DESCRIPTION OF ABILITY LEVEL OF CLASS

Ability Level	Number of Teachers	Percent (Approx.)
High	15	6
Medium	234	91
Low	9	3
	258	100

Most teachers described the children they taught as being medium ability.

TABLE 6: SPECIAL GROUPING FOR SCIENCE

Special Grouping	Number of Teachers	Percent (Approx.)
Yes	19	7
No	239	93
	258	100

Very few teachers reported that any special grouping arrangement was employed for teaching science.

TABLE 7: DESCRIPTION OF ORGANISATION OF SCIENCE TEACHING

Type of Organisation	Number Teachers	Percent (Approx.)
Teaching own class of one grade	176	68
Teaching own class composite	17	7
Teaching all science for a particular grade	12	5
Team teaching	17	7
Other	36	13
	258	100

Most teachers taught science to their own class comprising one grade while some taught science to their own class which was a composite. Taking both groups together some 75% of teachers taught science to the children they took for other subjects. A small number of teachers taught all science for a particular grade. Relatively few teachers reported using a team teaching approach while a significant proportion used the 'other' category in responding to the teacher deployment item. No doubt some of these could be described broadly as one of the four main choices given but it is interesting that such a large proportion of teachers perceived that they were doing something different.

TABLE 8: PRESENCE OF A SPECIAL ROOM FOR SCIENCE TEACHING

Special Room	Number of Teachers	Percent (Approx.)
Yes	26	10
No	231	90
	257	100

A small percentage of teachers reported that a special room for science teaching was present in the school in which they were teaching. For the vast majority of teachers this was not the case.

TABLE 9: INVOLVEMENT OF CHILDREN TAUGHT IN AGRICULTURAL PROJECT CLUB ACTIVITIES

Involvement	Number of Teachers	Percent (Approx.)
Yes	20	8
No	238	92
	258	100

Only a small percentage of teachers was actively involved in Agricultural Project Club activities.

3. *Teacher Characteristics*

(a) Education

Teachers were asked to provide information about their formal science education. Table 10 provides a breakdown of number of years teachers college science training against university science training, partitioned on secondary school science background. This cross-plot provides detailed information concerning four key groups of teachers. The four groups are, in effect, that composed of teachers reporting no teachers college science training; the group reporting one year teachers college science training; the group reporting two years of teachers college science training.

TABLE 10: SCIENCE EDUCATIONAL BACKGROUND OF TEACHERS: TEACHER COLLEGE SCIENCE PLOTTED AGAINST UNIVERSITY SCIENCE PARTITIONED ON SECONDARY SCHOOL SCIENCE BACKGROUND

Amount of Teacher College Science Education (Years)	Amount of Secondary School Science	University Science				Totals	
		None	Some	Major	Degree	Sub-Totals	Totals
Nil	None	15 (5.8)			1 (0.4)	16 (6.2)	
	1 or more Jnr Sc. Sub.	23 (8.9)				23 (8.9)	
	1 or more Snr Sc. Sub.	23 (8.9)				23 (8.9)	
	Sub-totals	61 (23.6)	0	0	1 (0.4)		62 (24.0)
1	None	21 (8.1)				21 (8.1)	
	1 or more Jnr Sc. Sub.	9 (3.4)				9 (3.4)	
	1 or more Snr Sc. Sub.	17 (6.6)	1 (0.4)			18 (7.0)	
	Sub-totals	47 (18.2)	1 (0.4)	0	0		48 (18.5)
2	None	15 (5.8)				15 (5.8)	
	1 or more Jnr Sc. Sub.	39 (15.0)				39 (15.0)	
	1 or more Snr Sc. Sub.	75 (29.0)	4 (1.5)			76 (30.5)	
	Sub-totals	129 (49.8)	4 (1.5)	0	0		133 (51.3)
3	None	3 (1.2)				3 (1.2)	
	1 or more Jnr Sc. Sub.	1 (0.4)				1 (0.4)	
	1 or more Snr Sc. Sub.	11 (4.2)	1 (0.4)			12 (4.6)	
	Sub-totals	15 (5.8)	1 (0.4)	0	0		16 (6.2)
TOTALS		252 (97.3)	6 (2.3)	0	1 (0.4)		259 (100)

For the group of respondents who had not studied science at a teachers college, 23 out of 61 (33.7%) had studied one or more Junior science subjects. A similar percentage had studied one or more Senior science subjects. Therefore the percentage of the group who received at least some secondary school science training was 67.5%.

For respondents reporting one year of teachers college science training, 21 (8.1% of the total) had not studied any science at a secondary school level and none had studied any science to any extent at all at a university level. Nine (3.4% of the total) had studied one or more Junior science subjects, 18 (7.0% of the total) had studied one or more Senior science subjects, and of these 18, one had some university science experience. Thus for this group, nine of the 48 (19.8%) had studied one or more Junior science subjects, 18 of the 48 (37.5%) had studied one or more Senior science subjects (one of these having studied some university science subjects). In this group therefore some 56.3% had at least some secondary school science training.

For respondents reporting two years of teachers college science training, 15 (5.8% of the total) had no secondary school science training, 39 (15.0% of the total) had studied one or more Junior science subjects, and 79 (39.5% of the total) had studied one or more Senior science subjects. Of these 79 who had studied one or more Senior science subjects, four (1.5% of the total) had studied some university science subjects. Thus for the group of respondents with two years teachers college science training, 39 of the 133 (29.3%) had studied one or more Junior science subjects, 79 of the 133 (59.4%) had studied one or more Senior science subjects. Of these 79 with some Senior science four had studied some science at a university level. In this group therefore 88.7% had studied at least some secondary school science.

For respondents reporting three years of teachers college science training, three (1.2% of the total) had not studied any science subjects at secondary school, one (0.4% of the total) had studied one or more Junior science subjects, and 12 (4.6% of the total) had studied one or more Senior science subjects. One of the twelve had studied some university science. Thus for the group of 16 respondents who had received three years of teachers college science training, one (0.25%) had studied one or more Junior science subjects, 12 (75%) had studied one or more Senior science subjects.

Two general trends can be noted. One is that, as the number of years of teachers college science training increases, the percentages of students with one or more Senior secondary school science subjects increases. This increase is from 37.5% for the one year group to 59.4% for the two year group to 75% for the three year group. Since three year courses were introduced more recently than two year courses, and since one year courses for primary teachers ceased some years ago, the results suggest that the general science background of teachers college entrants is increasing. This is confirmed by reference to the age distribution table (Table 19) which shows that some 32% of the respondents would have received their teacher training within the last eight years.

A second feature of the results shown in Table 10 is the number of blank cells for all levels of university science training. It can be appreciated that some teachers have not yet had time to study science subjects at a university level and of those with appropriate entry qualifications, many are unable to do so because science courses, on the whole, are not offered externally. The general science educational background of teachers seems to depend mainly on what is provided by the colleges.

(b) Sex, Age and Experience

Tables 11 to 13 show the teacher distribution by years of teaching, sex, and age.

TABLE 11: SEX OF TEACHERS

Sex	Number of Teachers	Percent (Approx.)
Male	88	34
Female	170	66
	258	100

TABLE 12: AGE OF TEACHERS

Years	Number of Teachers	Percent (Approx.)
Under 25	84	32
25–45	144	56
Over 45	30	12
	258	100

TABLE 13: LENGTH OF TEACHING EXPERIENCE (YEARS)

Years Teaching	Number of Teachers	Percent (Approx.)
0–3	70	27
4–5	42	16
6–10	69	27
more than 10	76	30
	257	100

A large proportion of teachers have been teaching less than ten years, the majority are female, and relatively few teachers are over 45 years of age.

Table 14 indicates teachers reported interest in science and scientific activities.

TABLE 14: TEACHERS EXPRESSED INTEREST IN SCIENCE AND SCIENTIFIC ACTIVITIES

Level	Number of Teachers	Percent (Approx.)
Very great	21	9
Great	135	56
Little	81	33
Very little	5	2
None	0	0
	242	100

Over one-third report that they have little or very little interest in science and scientific activities. More than half report that they have a great interest and some nine per cent report that they have a very great interest in sicnece and scientific activities. A moderately high positive correlation of 0.46 between years of teachers college science and interest in science and scientific activities was noted.

Perceptions of the Syllabus and Its Implementation

1. *Teaching and Preparation Time*

Tables 15 and 16 provide information on the time spent teaching science and the time spent in the preparation of science lessons.

TABLE 15: TIME SPENT EACH WEEK TEACHING SCIENCE

Time	Number of Teachers	Percent (Approx.)
None (you do not teach science)	8	3
Less than ½ hour	11	5
½ hour to 1½ hours	227	89
More than 1½ hours	9	3
	255	100

The majority of teachers reported that they teach science for a period of between ½ and 1½ hours per week. This is the suggested time allotment for the subject. Few reported teaching the subject for either greater or less than the suggested time.

Eight teachers reported not to be teaching science. These teachers were requested, in the questionnaire, not to answer further items but to state the arrangement for science teaching which was adopted. In nearly all cases these teachers stated that some other teacher was taking their class for the subject.

TABLE 16: TIME DEVOTED EACH WEEK TO THE PREPARATION OF SCIENCE LESSONS

Time	Number of Teachers	Percent (Approx.)
Less than ½ hour	98	40
½ hour to 1½ hours	146	58
More than 1½ hours	4	2
	248	100

Slightly less than half of the teachers reported that they spent less than half an hour per week in preparation whereas 60% reported that they spent more than half an hour per week in preparation. Of this 60%, four teachers reported that they spent more than one and a half hours preparing science lessons.

TABLE 17: ADEQUACY OF PREPARATION TIME

	Number of Teachers	Percent (Approx.)
Adequate	163	65
Inadequate	84	35
	247	100

The majority of teachers declared that they regarded the time they spent in preparation to be adequate. However a large minority regarded the time spent on preparation to be inadequate.

2. *The Extent to which Teachers Follow the Syllabus*

TABLE 18: EXTENT TO WHICH TEACHERS FOLLOW THE 1966 SCIENCE SYLLABUS

	Number of Teachers	Percent (Approx.)
Very closely	44	18
Moderately closely	188	75
Not at all (a different approach is used)	18	7
	250	100

Less than 20 per cent of teachers reported that they followed the 1966 Science Syllabus very closely when teaching science. Some 75% reported that they followed the syllabus moderately closely, while seven per cent reported that they were using a different approach.

3. *Adequacy of Time Allocation and the Importance of Science in the Primary School*

TABLE 19: ADEQUACY OF 1–1½ HOURS PER WEEK TIME ALLOCATION

	Number of Teachers	Percent (Approx.)
Very Adequate	55	23
Adequate	168	66
Inadequate	26	11
Very inadequate	1	0
	250	100

Few teachers regarded the time allocation to be inadequate. Only one teacher regarded the time allocation to be very inadequate.

TABLE 20: IMPORTANCE OF SCIENCE IN PRIMARY SCHOOL CURRICULUM

	Number of Teachers	Percent (Approx.)
Very important	93	37
Important	155	62
Unimportant	3	1
Very unimportant	0	0
	251	100

Approximately one-third of the teachers regarded science to be a very important subject in the primary school curriculum while approximately two-thirds of the teachers regarded science to be an important subject in the primary school curriculum. Only three teachers regarded the subject to be unimportant.

4. *Effectiveness of Teaching and Attainment of Aims*

TABLE 21: EFFECTIVENESS OF SCIENCE TEACHING

	Number of Teachers	Percent (Approx.)
Very effective	10	4
Effective	225	91
Ineffective	13	5
Very ineffective	0	0
	248	100

The majority of teachers regarded their teaching of science to be either effective or very effective. Of these, however, only a minority regarded their teaching to be very effective but very few reported their teaching to be ineffective.

Table 22 shows the extent to which teachers perceived each of the aims of Primary Science Syllabus to be achieved with respect to the classes they teach.

TABLE 22: EXTENT TO WHICH THE AIMS OF THE SCIENCE SYLLABUS ARE ACHIEVED

Aims of Science Syllabus	Number of Teachers	Mean	S.D.	Degree of Success*
				Not at all (1) / Slightly Successful (2) / Moderately Successful (3) / Very Successful (4)
The stimulation and development of the child's natural curiosity and interest in the world around him	251	3.15	0.63	
The development of skills and attitudes involved in using the methods of science to reach new knowledge	251	2.35	0.68	
The development of an understanding of the generalisations of science	248	2.50	0.71	
The development of a sense of responsibility for the conservation of natural resources	251	3.20	0.70	
The development of an understanding of the essential nature of science and an appreciation of its romance, power, limitations and impact on our way of life	250	2.36	0.75	

* Mean and S.D. Plots for Each Question

The fact that relatively low ratings were given to aims concerned with skill development and knowledge suggests that despite the belief of the majority that their teaching is effective, lack of formal science education for many may be a problem.

The last aim which captures some feelings scientists might hold also received a very low rating.

5. *Extent to which Various Teaching Strategies were Used*

A total of 31 activities and teaching techniques which might be used in science were listed. Each teacher was asked to rate each of these in terms of how extensively they were employed in his or her teaching program. As a check for the comprehensiveness of the list, teachers were asked to list and rate other activities they used. While 43 teachers (16.6%) listed one or more additional activity used, only eight of these constituted an activity other than those included in the list. The rest were only minor variations of those listed. In most cases the additional activities involved working with specific science materials (a variation of item 24) or working in special outdoor situations (a variation of item 7). The 31 items could therefore be regarded as being representative of the teaching strategies and activities used by teachers.

By plotting the mean for each of the 31 items the relative extent to which each of the strategies used could be ascertained. The standard deviation for each item represents the degree to which the total teacher group varied in the ratings given to an item. A low standard deviation of 0.5 as shown for item 23 (concerning guest speakers) indicates that teachers differed little in the ratings given. On the other hand a high standard deviation of 1.28 as shown for item 28 (concerning written evaluation other than weekly) indicates that teachers differed widely in the ratings given.

Table 23 summarises the ratings teachers gave to their use of the various teaching strategies in the teaching of science.

The three most extensively used strategies in descending order were:

(9) Pupils record notes in a science notebook (mean 3.44);

(31) Evaluation by oral questioning at the end of each lesson (mean 3.39); and

(16) Exposition by teacher with teacher/pupil questioning (mean 3.31).

The three least extensively used strategies were:

(27) Evaluation with a written science test weekly (mean 1.15);

(23) Use of guest speakers (mean 1.20); and

(20) Pupils copy notes from syllabus (mean 1.23).

While the means shown in Table 23 provide a basis for ordering strategies and activities in terms of the average extent to which teachers rate their use, no insights are provided on the interrelationships of items or the structure underlying this interrelationship. Furthermore, the way the data is presented in Table 23 provides no insights into how different teachers constitute groups based on a common teaching style. These issues are explored as a separate topic in a later section of the report.

TABLE 23: EXTENT TO WHICH TEACHERS USE VARIOUS TEACHING STRATEGIES

Teaching Techniques and Activities	Number of Teachers	Mean	S.D.	Extent of Use*
				Not at all / Very well / Little / Great / Very Great
				1 2 3 4 5
1. Pupils watch T.V. lessons	250	2.99	1.09	
2. T.V. lessons are the basis for other science lessons	250	2.60	1.09	
3. Teacher demonstrates experiments	250	2.87	1.04	
4. Pupils demonstrate experiments	250	2.49	1.09	
5. Pupils perform their own experiments and handle apparatus	250	2.52	1.17	
6. Pupils spend science period in library	250	1.72	1.01	
7. Pupils have science lessons outside the classroom or library, e.g. in school grounds, at swimming pool	250	2.56	1.03	
8. Pupils go on organised excursions	250	2.03	1.01	
9. Pupils record notes in a science notebook	250	3.44	1.25	
10. Pupils undertake group science projects	250	2.73	1.24	
11. Each pupil undertakes his own science project	250	2.39	1.26	
12. Pupils discuss topics or problems in small groups	250	2.55	1.19	
13. Pupils investigate problems suggested by the teacher	250	2.88	1.06	
14. Pupils investigate problems suggested by class members	248	2.27	0.96	
15. Investigations involving science and other study areas, e.g. mathematics, social studies	247	2.74	1.03	
16. Exposition by teacher with teacher/pupil questioning	248	3.31	1.01	
17. Exposition by teacher followed by group discussion	248	2.75	1.12	
18. Teacher uses science trolley	248	1.93	1.25	
19. Pupils use science trolley	247	1.61	0.95	
20. Pupils copy notes from the syllabus	248	1.23	0.60	
21. Pupils copy notes from other sources e.g. books	248	2.27	1.22	
22. Pupil lecturettes	248	2.60	1.12	
23. Guest speakers	248	1.20	0.52	
24. Pupils use special kits of science materials	248	1.56	0.95	
25. Pupils watch films (without follow-up discussions)	248	1.67	0.94	
26. Pupils discuss film sequence	247	2.53	1.21	
27. Evaluation with a written science test — weekly	246	1.15	0.51	
28. Evaluation with a written science test — other than weekly	248	2.52	1.28	
29. Evaluation weekly with oral science questions	247	2.23	1.23	
30. Evaluation by oral questions at the beginning of each lesson	247	2.79	1.11	
31. Evaluation by oral questions at the end of each lesson	247	3.39	1.01	
				1 2 3 4 5

* Mean and S.D. Plots for Each Question

6. *Differences among Topic Areas of the Syllabus in Terms of:*

(a) Interest

There are two ways of examining the concept of pupil interest in topic areas of the syllabus on the basis of information obtained from teachers. One is to ask teachers to rank each of the five topic areas (Living Things, Conservation, Earth in Space, Surface of the Earth, and Energy) according to how much each area appears to arouse the interest of pupils. The second is to ask teachers to select one of the five areas which arouses most interest and then select one which arouses least interest. This second approach allows interest for each area to be assessed in terms of the proportion of respondents who rate it most interesting as opposed to the proportion of respondents who rate it least interesting. This second procedure was adopted for this questionnaire since it reduces to some extent the number of individual decisions required of respondents.

Table 24 shows the teacher ratings of the topic areas of the syllabus on the "most interesting" dimension.

TABLE 24: MOST INTERESTING TOPIC FOR CHILDREN

Topic Area	Number of Teachers	Percent (Approx.)
Living Things	123	54
Conservation	13	6
The Earth in Space	66	29
The Surface of Earth	8	3
Energy	18	8
	228	100

Of the total respondents 228 (88%) answered this item.

A majority of teachers (54%) rated "Living Things" as the most interesting topic area for children. Just over one-quarter (29%) rated "The Earth in Space" as the most interesting topic area. Very few teachers rated either of the other three topic areas as most interesting.

Table 25 shows the teacher ratings of the topic areas of the syllabus as the least interesting dimension. Of the total respondents only 180 (69.5%) answered this item.

TABLE 25: LEAST INTERESTING TOPIC FOR CHILDREN

Topic Area	Number of Teachers	Percent (Approx.)
Living Things	11	6
Conservation	43	24
The Earth in Space	22	12
The Surface of Earth	50	28
Energy	54	30
	180	100

It can be seen that some difference in order is evident when Tables 24 and 25 are compared. While "Living Things" received the highest rating on the most interesting dimension and the lowest rating on the least interesting dimension, and the area "Earth in Space" which received the second highest rating for on the most interesting dimension also received the second lowest rating on the least interesting dimension, the relative order for the other areas does not exhibit the same degree of consistency.

In part the relative changes in order for the other three topic areas on the "most" versus "least" ratings is due to the relatively small number of teachers who rated these topics. In part it is due to the fact that many teachers who made ratings on the first dimension did not make ratings on the second. (Six teachers rated the second area but not the first.)

Nevertheless by far the most interesting area to children in terms of teachers' rating is "Living Things". The second most interesting topic area is "The Earth in Space". The other three areas were rated consistently less interesting.

(b) Teaching Difficulty

Tables 26 and 27 show teachers ratings of topic areas on a "most–least" basis of difficulty to teach.

TABLE 26: TOPIC AREA MOST DIFFICULT TO TEACH

Topic Area	Number of Teachers	Percent (Approx.)
Living Things	15	7
Conservation	35	18
The Earth in Space	71	36
The Surface of Earth	25	12
Energy	53	27
	199	100

In terms of greatest difficulty, "The Earth in Space", followed by "Energy" received high 36% and 27% frequency counts while "Living Things" received the lowest (7%).

TABLE 27: TOPIC AREA LEAST DIFFICULT TO TEACH

Topic Area	Number of Teachers	Percent (Approx.)
Living Things	115	53
Conservation	52	24
The Earth in Space	21	10
The Surface of Earth	6	
Energy	21	10
	215	100

For least difficulty, "Living Things" received the highest (53%) frequency count, while "Energy", "The Earth in Space" and "Surface of Earth" received low frequency counts (10%, 10% and 3%) respectively.

(c) Availability of Resource Materials

Tables 28 and 29 show teachers ratings of topic areas on a "most–least" basis of availability of Resource Material.

TABLE 28: RESOURCE MATERIALS MOST READILY AVAILABLE

Topic Area	Number of Teachers	Percent (Approx.)
Living Things	140	68
Conservation	9	4
The Earth in Space	24	12
The Surface of Earth	13	6
Energy	20	10
	206	100

Some 60% regarded the topic area "Living Things" as the one for which resource material was most readily available. Very few teachers rated either "Conservation" (4%) or "Surface of Earth" (6%) as areas where resource material was readily available. These views are confirmed on the ratings of least readily available shown in Table 29.

TABLE 29: RESOURCE MATERIALS LEAST READILY AVAILABLE

Topic Area	Number of Teachers	Percent (Approx.)
Living Things	7	4
Conservation	61	36
The Earth in Space	46	27
The Surface of Earth	17	10
Energy	40	23
	171	100

It is the areas "Conservation" (36%), "The Earth in Space" (27%) and "Energy" (23%) which relatively large proportions of teachers rated as being areas where resource material was least readily available.

(d) Adequacy of Apparatus

Tables 30 and 31 show the percentage of teachers rating each of the topic areas in terms of adequacy of apparatus.

TABLE 30: TOPIC AREA IN WHICH APPARATUS WAS RATED MOST ADEQUATE

Topic Area	Number of Teachers	Percent (Approx.)
Living Things	41	33
Conservation	3	2
The Earth in Space	8	6
The Surface of Earth	14	11
Energy	59	48
	125	100

TABLE 31: TOPIC AREA IN WHICH APPARATUS WAS RATED LEAST ADEQUATE

Topic Area	Number of Teachers	Percent (Approx.)
Living Things	15	12
Conservation	20	15
The Earth in Space	64	50
The Surface of Earth	10	8
Energy	19	15
	128	100

The areas "Energy" (48%) and "Living Things" (33%) were most frequently rated for apparatus as most adequate, whereas the area "The Earth in Space" was most frequently rated for apparatus being least adequate.

(e) Relationships between Children's Interest and Ease of Teaching

A cross-plot of the frequency of responses to the questions dealing with topic areas seen to be most interesting and the areas seen to be least difficult to teach is shown in Table 32. It is likely that the topic seen as most interesting to students by a teacher might also be seen as the one which was least difficult to teach. If this were so, then the left to right diagonal cells of the cross-plot table would contain relatively high numbers while the off-diagonal cells would contain relatively low numbers. This is true only of the area "Living Things" in which 73 teachers out of 108 rated this topic as both least difficult and most interesting to teach. Since the magnitude of the diagonal elements for practically all other comparisons are relatively small compared with the off-diagonal elements it might be concluded that there is no strong relationships between teacher's perceptions of difficulty of a topic in teaching terms, and their perceptions of children's interest in that topic.

TABLE 32: CROSS-PLOT OF TEACHERS RATING OF TOPIC AREA MOST INTERESTING AGAINST TOPIC AREA LEAST DIFFICULT TO TEACH

			LEAST DIFFICULT TO TEACH					
			Energy	Surface of Earth	Earth in Space	Conservation	Living Things	ROW TOTAL
			1	2	3	4	5	
MOST INTERESTING	Energy	1	9 (4.4)		1 (0.5)	4 (2.0)	3 (1.5)	17 (8.4)
	Surface of Earth	2	1 (0.5)	1 (0.5)	1 (1.5)	3 (1.5)	2 (1.0)	8 (3.9)
	Earth in Space	3	5 (2.5)	3 (1.5)	13 (6.4)	14 (6.9)	23 (11.3)	58 (28.6)
	Conservation	4			3 (1.5)	4 (2.0)	5 (2.5)	12 (5.9)
	Living Things	5	6 (3.0)	2 (1.0)	3 (1.5)	24 (11.8)	73 (36.0)	108 (53.2)
	COLUMN TOTAL		21 (10.3)	6 (3.0)	21 (10.3)	49 (24.1)	106 (52.2)	203 (100.0)

7. *Apparatus and Resource Material Supply and Availability*

Table 33 provides an indication of teachers' views on the appropriateness of apparatus available to them in their school for science teaching.

TABLE 33: APPROPRIATENESS OF SCIENTIFIC APPARATUS

	Number of Teachers	Percent (Approx.)
Very appropriate	7	3
Appropriate	153	65
Inappropriate	53	23
Very inappropriate	21	9
	234	100

Approximately 66% of teachers rated the apparatus available to them in their school as either appropriate or very appropriate, whereas some 32% regarded the apparatus to be either inappropriate or very inappropriate.

Table 34 provides an indication of teachers' views of the rate of issue of scientific apparatus.

TABLE 34: RATE OF ISSUE OF SCIENTIFIC APPARATUS

Rate	Number of Teachers	Percent (Approx.)
Very adequate	2	1
Adequate	157	71
Inadequate	43	19
Very inadequate	20	9
	222	100

Some 72% of the respondents regarded issue rates of apparatus to be either adequate or very adequate while 28% regarded issue rates to be either inadequate or very inadequate.

Table 35 provides an indication of teachers' views concerning the availability of such teacher resource materials as teacher reference books.

TABLE 35: AVAILABILITY OF TEACHER RESOURCE MATERIALS

Availability	Number of Teachers	Percent (Approx.)
Very adequate	46	19
Adequate	150	63
Inadequate	32	13
Very inadequate	12	5
	240	100

Some 82% rated teacher resource material availability to be either adequate or very adequate, whereas only 18% rated teacher resource material availability to be inadequate or very inadequate.

Table 36 provides an indication of teachers' views concerning the availability of pupil resource material such as pupil books and kits. Only 66% regarded pupil resource material availability to be either adequate or very adequate while some 34% regarded the availability of this kind of material to be either inadequate or very inadequate.

TABLE 36: AVAILABILITY OF PUPIL RESOURCE MATERIAL

Availability	Number of Teachers	Percent (Approx.)
Very adequate	18	7
Adequate	143	59
Inadequate	60	25
Very inadequate	20	9
	241	100

For each of the four questions in the questionnaire which related to appropriateness of apparatus, rate of issue of apparatus, adequacy of teacher resource material and adequacy of pupil resource materials, teachers who gave ratings indicating they were dissatisfied were asked to offer positive suggestions in the form of an open-ended comment. Some 77 teachers made comments concerning the types of apparatus they would like to have available. Some of these comments indicated that the kind of apparatus available in secondary school science laboratories would satisfy the needs of these teachers. A number of comments reflected a need for more apparatus already on supply. This suggests that teachers do not regard the apparatus on supply to be readily available.

Fifty-two teachers made comments concerning the kind of issue rate they would like. Nearly all of these comments were terse and suggested that more of everything was all that was needed.

Some 46 teachers commented on the topic of teacher resource materials. The question asked teachers to list the types of materials they would like to have available. The majority of comments suggested a lack of familiarity of the kind of teacher reference material and pupil material already being supplied.

Seventy-seven teachers commented on the types of pupil resource material they would like to have available. In most instances no specific kinds of materials were suggested.

On the whole the comments for each of the four areas were not very specific and gave little insight into why "negative" ratings were given.

8. *The Importance of Various Kinds of Assistance*

Table 37 and 38 indicate teachers' preferences for guidance in experimental techniques and in the selection of experiments.

TABLE 37: NEED FOR GUIDANCE IN EXPERIMENTAL TECHNIQUES

Extent of Need	Number of Teachers	Percent (Approx.)
Very great	34	14
Great	93	39
Little	78	33
Very little	25	10
Not at all	10	4
	240	100

TABLE 38: NEED FOR ASSISTANCE IN SELECTION OF EXPERIMENTS

Extent of Need	Number of Teachers	Percent (Approx.)
Very great	33	14
Great	94	39
Little	75	31
Very little	25	11
Not at all	13	5
	240	100

In each case just over half of the teachers regarded their need to be great to very great while the other half regarded their need to be little or not at all.

Table 39 shows the relative importance of a number of other kinds of assistance as seen from teachers' ratings. The three most important kinds of assistance were: Hints and Tips for Science Teaching; In-Service Science Workshops; and Lists of Science Resources. The three least important kinds of assistance were: Construction of a New Syllabus; Revision of the Present Syllabus; and Science Advisory Teachers. On the whole, however, the difference in ratings was not extremely great.

TABLE 39: RELATIVE IMPORTANCE OF CATEGORIES OF ASSISTANCE AND CHANGE

Items Rated in Terms of Importance	Number of Respondents	Mean	S.D.	Extent of Importance*
				Very little (1) / Little (2) / Great (3) / Very great (4)
1. In-service science workshops	241	3.49	0.59	
2. In-service seminars	243	3.27	0.69	
3. Information statements on new science teaching techniques	244	3.36	0.58	
4. Resource reviews of science materials e.g. books	244	3.27	0.61	
5. Curriculum papers on aspects of science teaching	243	3.35	0.61	
6. Lists of science resources	244	3.39	0.63	
7. Hints and tips for science teaching	245	3.57	0.54	
8. Science advisory teachers	237	3.24	0.74	
9. A revision of the present syllabus	240	2.88	0.88	
10. A construction of a new syllabus	235	2.74	1.00	

* Mean and S.D. Plots for each Question

It would seem therefore that all kinds of assistance would be most welcome. However syllabus revision or reconstruction are not seen to be nearly as important as other forms of assistance.

SECTION 2: Teaching Strategies and Patterns of Teaching

1. *Principal Teaching Strategies*

Teachers' reports of the extent to which they used various activities and techniques in teaching science were discussed in Part 2(5) of the previous section.

It will be recalled that 31 items relating to teaching activities and techniques were rated. Of the 259 respondents only 202 rated all the items. For various reasons 57 teachers failed to rate one or more items.

In order to derive the fundamental dimensions being measured by the 31 items, a principal axis factor analysis followed by a varimax rotation was employed with the data from the 202 teachers who responded to all items. Six factors emerged which together accounted for a major part of the variability among teachers in their approach to teaching.

The six factors which emerged, together with their item loadings, are shown in Table 40.

TABLE 40: FACTOR STRUCTURE OF TEACHING STRATEGIES

	FACTOR 1: APPARATUS USAGE AND EXPERIMENTATION	
3	teachers demonstrate experiment	.57
4	pupils demonstrate experiment	.64
5	pupils perform own experiment	.70
18	teachers use science trolley	.79
19	pupils use science trolley	.82
24	pupils use special kits of science material	.39
	FACTOR 2: PUPIL INVOLVEMENT AND PROBLEM SOLVING	
10	pupils undertake group science projects	.53
11	each pupil undertakes own science project	.52
12	pupils discuss topics or problems (small groups)	.71
13	pupils investigate problems suggested by teacher	.66
14	pupils investigate problems suggested by class members	.65
15	investigations involving science and other study areas	.66
17	exposition by teacher followed by group discussion	.51
22	pupil lecturettes	.43

TABLE 40 (continued)

	FACTOR 3: ORAL WORK AND ORAL EVALUATION	
16	exposition by teacher with teacher/pupil questions	.71
29	evaluation weekly with oral science questions	.57
30	evaluation by oral questions at beginning of each lesson	.61
31	evaluation by oral questions at end of each lesson	.61
	FACTOR 4: OUTSIDE, EXTERNAL NON–TEACHER DIRECTED ACTIVITY	
7	pupils have lessons outside classroom	.46
8	pupils go on organised excursions	.65
20	pupils copy notes from syllabus	.35
23	guest speakers	.61
25	pupils watch films without follow-up discussions	.55
	FACTOR 5: TELEVISION MEDIA INSTRUCTION	
1	pupils watch T.V. lessons	.82
2	T.V. lessons are a basis for other science lessons	.78
26	pupils discuss film sequences	.36
	FACTOR 6: WRITTEN WORK AND WRITTEN EVALUATION	
6	pupils spend science period in library	.38
9	pupils record notes in science notebook	.65
21	pupils copy notes from other sources	.72
27	evaluation by written science tests – weekly	.37
28	evaluation by written science tests – other than weekly	.65

From Table 50 it can be seen that Factor 1 related to apparatus use and experimentation, items loading heavily on Factor 2 related to pupil involvement in projects of various kinds and problem solving. Items which loaded heavily on Factor 3 concerned oral work and oral evaluation. Items loading heavily on Factor 4 concerned work outside the classroom, note copying from the syllabus, use of guest speakers, and watching films without follow-up discussion. This factor appears to indicate a teaching strategy in which the teacher has very little direct involvement. Factor 5 loaded heavily on items related to the use of television and media while Factor 6 loaded on items concerned with written work and written evaluation.

It would seem therefore that six main components of teaching emerge from the 31 items. These involve an emphasis on:

1. Apparatus usage and experimentation
2. Pupil involvement and problem-solving
3. Oral work and oral evaluation
4. Outside, external, non-teacher directed activity
5. Television and media instruction
6. Written work and written evaluation.

In order to find out what kinds of styles characterise the teachers in the sample, factor scores for each of the teachers were computed. By multiplying each teacher's 31 scores by the appropriate factor score co-efficient and summing these for each of the six factors, six factor scores were computed for each teacher. This means each teacher has a score on each of the six main components which emerged from the principal axis factor analysis. Furthermore, since the analysis produces uncorrelated components, differences among teachers in terms of their factor scores represent true differences in teaching patterns or styles.

2. *Patterns of Teaching*

In order to find out how much variety in style existed among the teachers in the sample, all teachers with complete data (202), were grouped on the basis of similarity of the six factor scores representing the main strategy components. The procedure used was one of cluster analysis in which people are classified into groups on the basis of score profile similarity. The particular approach used in this study involved the use of Hierarchical Grouping Analysis (Veldman 1967) followed by discriminant analysis to ascertain the maximum number of distinctly different groups. The analysis produced five groups whose profiles are defined by each group's mean on the six sets of factor scores. These means are shown in Table 41.

TABLE 41: TEACHER GROUPS MEANS AND STANDARD DEVIATIONS ON FACTOR SCORES (COMPONENTS OF TEACHING)

	Group 1 (N=69)		Group 2 (N=61)		Group 3 (N=39)		Group 4 (N=18)		Group 5 (N=15)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
1. Apparatus Usage and Experimentation	+.46	.61	+.37	.72	−1.45	.66	+.52	.54	−0.51	.73
2. Pupil Involvement and Problem Solving	+0.41	.87	−0.64	1.06	+0.06	.80	+0.58	.76	−0.12	.42
3. Oral Work and Oral Evaluation	−0.52	.75	+.003	.80	+.21	.85	+1.82	.67	−0.33	.63
4. Outside, External Non-Teacher Directed Activity	+0.19	.72	+0.14	.80	+0.42	.87	−0.35	.62	−2.14	.75
5. Television Media Instruction	−0.55	.66	+.71	.82	−0.11	1.07	+.17	1.05	−0.26	.96
6. Written Work and Written Evaluation	+.18	.96	+.13	1.12	−0.28	.77	+.04	.93	−0.73	.78

The overall item means shown in the early part of the report (Part 2[5] Table 23) do not give precise information on how strategies and activities are linked to form a set of principal teaching components or factors. When these factors were identified and teachers grouped in terms of their patterns of emphasis represented by the factor scores on these components and activities the clearly different patterns of teaching of primary school science can be seen.

Each of the five group's means on each of the six factors were plotted to represent a group profile showing relative emphasis on the combination of the teaching strategies employed.

An overall comparison of the five groups, which represent the least number of significantly different or distinct sets of teachers, may be seen in Figure 1 which shows patterns of difference in teaching strategies.

The two groups which each contain a relatively large number of teachers are Group 1 (34.2%) and Group 2 (30.2%). The profiles of each of these groups represent the two most common emphasis patterns as far as teaching strategy usage is concerned.

Since factor scores are unit normalised, the overall mean or average emphasis for each of the factors is zero and group mean scores range above and below this average. Where a mean is above the zero relatively high emphasis is placed on the strategy and where the mean is below zero relatively low emphasis is placed on the strategy.

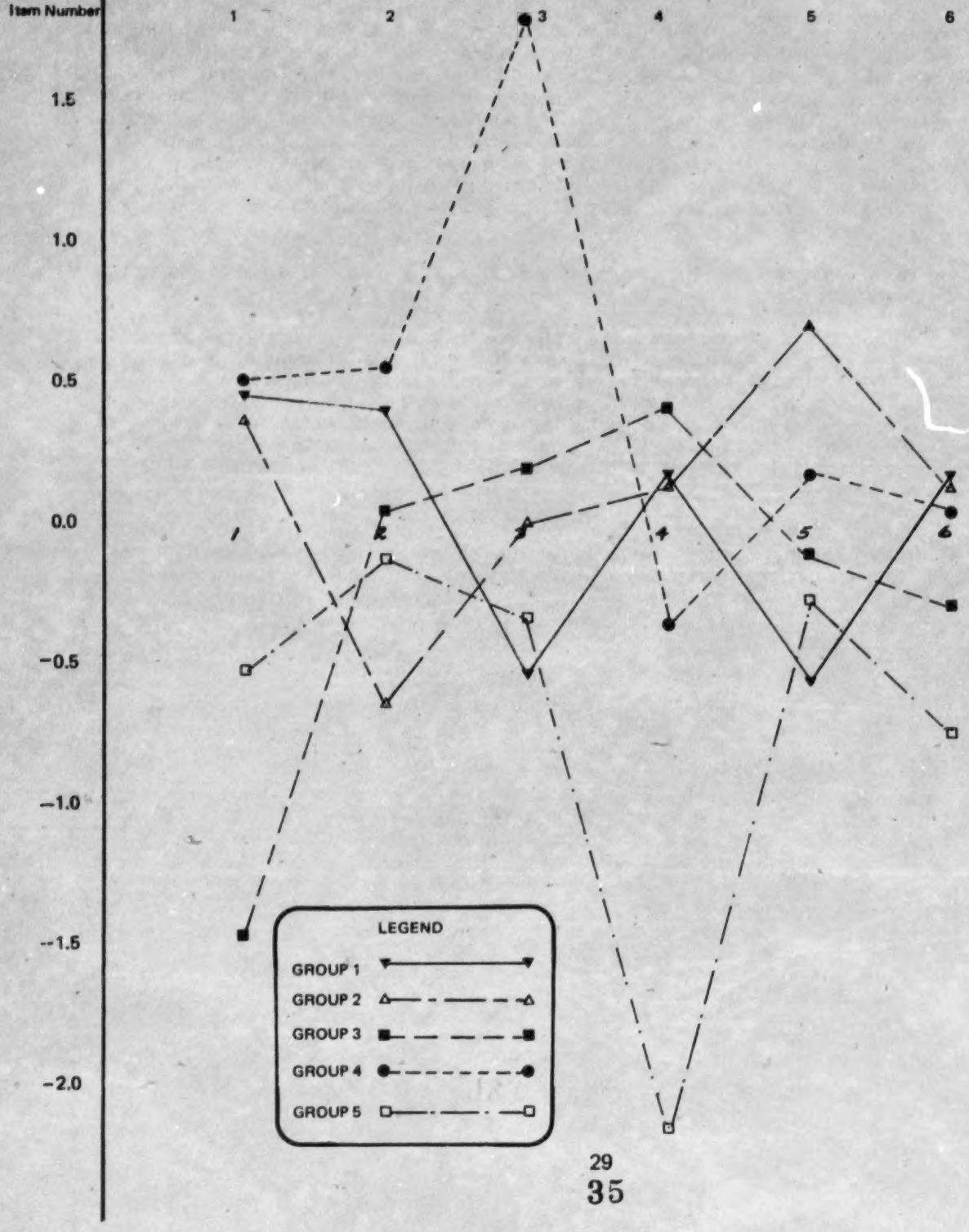
The pattern of emphasis for Group 1 (comprising 34.2% of the sample) is characterised by a set of means which centre around the overall mean. There was a marked de-emphasis on oral work and oral evaluation (Factor 3) and on television and media instruction (Factor 5).

For Group 2 the mean emphasis for apparatus usage and experimentation (Factor 1) is approximately half a standard deviation above the mean of all groups for this factor; just over half a standard deviation below the overall mean for pupil involvement and problem-solving (Factor 2); nearly on the overall mean for oral work and oral evaluation (Factor 3); slightly above the overall mean for external and non-directed activity (Factor 4); more than half a standard deviation above the overall mean for television and media instruction (Factor 5); and only very slightly above the overall mean for emphasis on written work and written evaluation (Factor 6).

It should be noted that relative to Group 2, there are in the case of Group 1 very marked differences on pupil involvement and problem solving (Factor 2) and to a less extent on oral work and oral evaluation (Factor 3). It should also be noted that of all groups, the Group 1 mean for written evaluation (Factor 6), was higher than that for any of the other groups.

Groups 1 and 2 together contained 64.4% of all the teachers in the sample. The two patterns represented by these groups are the two most common. The third most common pattern is that of Group 3 comprising 19.3% of teachers in the sample.

FIGURE 1: FACTOR SCORE PROFILES FOR ALL GROUPS



The mean emphasis for apparatus usage and experimentation (Factor 1) is almost one and a half standard deviations below the overall mean and in terms of all other groups this particular group places least emphasis of all on this strategy. For pupil involvement and problem solving (Factor 2) the mean of Group 2 differs little from the overall mean; for oral work and oral evaluation (Factor 3) the mean emphasis is slightly above the overall mean and lies almost half way between the means of Groups 1 and 2 for this strategy. For emphasis on outside, external and non-teacher directed activity (Factor 4) the mean of Group 2 is above all other groups. For emphasis on television and media instruction (Factor 5) the mean for Group 3 is slightly below the overall mean and, for written work and written evaluation (Factor 6) the mean of Group 3 is also below the overall mean. Of all groups Group 3 gives least emphasis on apparatus usage and experimentation and, with the exception of Group 5, Group 3 also gives least emphasis to written work and written evaluation.

Groups 4 and 5 are distinctly minority groups in terms of percentage of teachers of which they are comprised.

Group 4, of all groups, emphasises most apparatus usage and experimentation (Factor 1) pupil involvement, and problem solving (Factor 2). A most notable feature of this group is the emphasis placed on oral work and oral evaluation (Factor 3). The mean for this factor is almost two standard deviations above the overall mean. This group is also characterised by a de-emphasis on outside, external and non-teacher directed activity (Factor 4) only a moderate amount of emphasis on television and media instruction (Factor 5) and a slight amount of emphasis on written work and written evaluation (Factor 6).

Group 5 is characterised by a de-emphasis of practically all components of teaching strategies. The most notable feature is the very low emphasis on outside, external and non-teacher directed activity (Factor 4) which is over two standard deviations below the overall mean.

SECTION 3: Needs for Assistance

In Part 2 of Section 1, teachers' views of the importance of various kinds of assistance were reported. Table 39 in Section 1, indicated the relative importance of each of ten kinds of assistance. Given the relatively large standard deviation, which is an index of the spread of ratings given by the members of the sample, it is possible that a number of significantly different sub-groups of teachers existed.

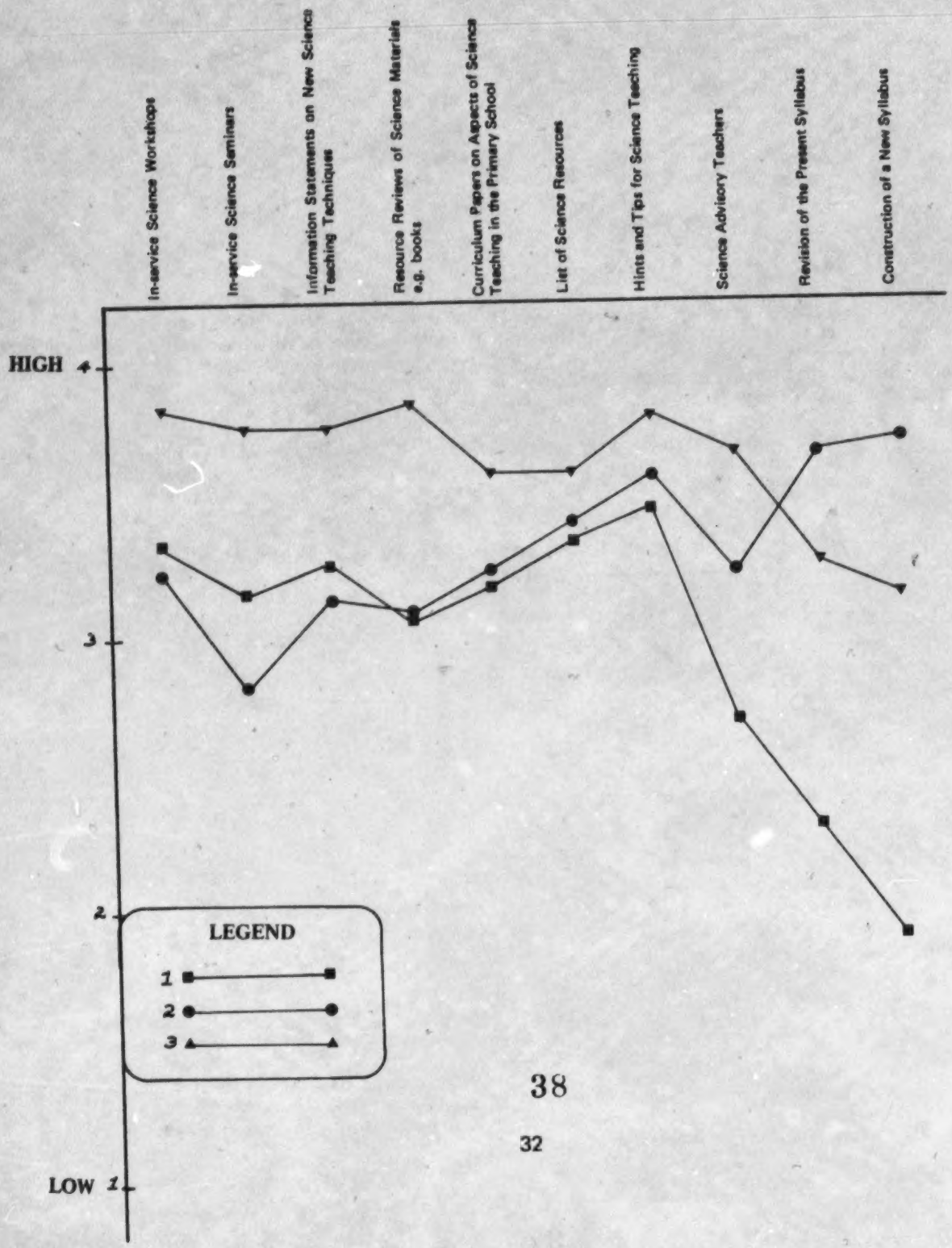
The cluster analysis technique was employed with the raw scores of all teachers (221) who had answered all ten items. The least number of significantly different groups which were identifiable was three. The item means for each of these groups is shown in Table 42.

TABLE 42: TEACHER GROUP MEANS ON IMPORTANCE OF KINDS OF ASSISTANCE

		Group 1 N=124	Group 2 N=44	Group 3 N=53
1.	In-service Science Workshops	3.35	3.25	3.82
2.	In-service Science Seminars	3.16	2.82	3.79
3.	Information Statements on New Science Teaching Techniques	3.27	3.14	3.79
4.	Resource Reviews of Science Materials e.g. books	3.06	3.10	3.85
5.	Curriculum Papers on Aspects of Science Teaching in the Primary School	3.18	3.25	3.61
6.	Lists of Science Resources	3.35	3.42	3.61
7.	Hints and Tips for Science Teaching	3.47	3.60	3.82
8.	Science Advisory Teachers	2.71	3.25	3.68
9.	Revision of the Present Syllabus	2.35	3.67	3.29
10.	Construction of a New Syllabus	1.91	3.72	3.15

Figure 2 shows the profile for each of the three groups on the ten need items. The groups differed most on Items 9 and 10 which concern syllabus reconstruction and syllabus revision respectively. The groups also differed markedly on Item 8 which concerns science advisory teachers.

FIGURE 2: PROFILE OF GROUPS ON KINDS OF ASSISTANCE



The profile of Group 3 which comprises 24% of the 221 teachers included in the analysis, is characterised by relatively high ratings on all items with the exception of those two concerned with syllabus change. This profile suggests that all of the first eight kinds of assistance are of very great importance. Relatively less importance however, was attached to lists of science resources and science advisory teachers.

The profile of Group 2 which comprises some 20% of teachers and the profile of Group 1 are quite indistinguishable on Items 4, 5 and 6. Furthermore, the two profiles, with the exception of the two items relating to syllabus change had the same general shape. In-service science workshops are seen to be more important than are seminars. Information statements on new science teaching techniques are seen to be more important that resource reviews. Hints and tips for teaching science are seen to be more important than lists of science resources or curriculum papers. In fact hints and tips rate with workshops as the most important requirement.

There was for all groups a tendency, relative to other items, to rate the one concerned with science advisory teachers somewhat lower than most other kinds of assistance. The wide disparity on the syllabus revision items is the most striking feature of the profiles of the three groups. At least half (56% Group 1) see these two as being of little importance, a further 24% (Group 3) see them of less importance than any other form of assistance. Group 2 (20% of teachers) on the other hand, see both reconstruction and revision as the most important features of all.

SECTION 4: Summary and Conclusion

The results of this survey provide information about how teachers in the region sampled, view the context in which science teaching occurs, the adequacy of the present syllabus, and the way the syllabus is being implemented. The key underlying assumption is that the opinions of people actually teaching the subject provide valuable insights into the status of science teaching in primary schools. Certainly it is possible that on some issues scientists, curriculum writers and others might not necessarily agree with some of the opinions which teachers express. Dissonance on any issue in no way negates the assumption that teachers' views are important. It might indicate however, that special attention be given to interpreting such results.

In some respects the results of the survey merely confirm empirically what might be suspected intuitively. In others the results provide information not readily available from unsystematic observation or intuition.

Information about the general context in which science teaching occurs is provided in Section 1, Part 1 of the results. These results indicate that for the majority of children in the region sampled, the basic form of organisation for science teaching is a single, self-contained, non-composite classroom unit. The ratio of female to male teachers is about 2 to 1. The majority of teachers have been teaching for less than ten years. Nearly one-third are under 25 years of age. It appears therefore that most children are learning science in a traditional classroom setting, and are being taught by relatively young teachers, most of whom are female. Exceptions, although involving a relatively small minority, do exist. In some ways the exceptions are of interest because they indicate departures from the traditional.

For instance, about 12% of classrooms were described as multiple area; about eight per cent of all classes comprise children assigned on the basis of ability; and seven per cent of teachers report that special grouping for science teaching is undertaken. A few teachers taught all the science for a particular grade and some teachers reported using a team-teaching approach. Furthermore, some 13% of teachers claimed that some kind of teacher deployment other than those listed in the questionnaire, was used. Some 10% of teachers reported having access to a room specially arranged for science teaching and eight per cent of the teachers reported that they were actively involved in Agricultural Project Club activities. A closer examination of some of these exceptions might be worthwhile. It might well be that such features as the use of a special science room, open plan classrooms, and the other kinds of teacher deployment have a desirable effect on the teaching/learning process. Perhaps some departures from the traditional might provide guidelines for further developments.

In terms of specific science qualifications, the results show that very few teachers (less than three per cent) had studied one or more university science subjects. Most teachers

had studied at least one science subject to a Junior level at secondary school and many had studied at least one science subject to a Senior level. For the majority, teachers colleges were the only source of post-secondary science training. The amount of teacher college science training varied, but most attended a teachers' college for two years. Teachers not trained at other tertiary institutions now attend teachers' college for three years. If the present results are any indication, the amount of secondary school science studied by these teachers prior to entering teachers college is increasing. Thus, while many teachers reported having relatively limited formal training in science, it can be expected that this will increase.

Just under two-thirds of the teachers reported that their expressed interest in science and scientific activities was great to very great. A very significant 35% however, reported their interest to be little to very little. This relatively large minority group might be a source of concern.

Information about syllabus implementation is provided in Section 1 Part 2 of the Results. On the whole these tend to indicate a general pattern of conformity to, and acceptance of, the present syllabus. Most teachers teach the subject within the suggested time period; claim to spend more than half an hour in preparation; regard both preparation and teaching time as adequate to very adequate; and follow the syllabus moderately closely. Nearly all the teachers see science as a primary school subject to be important to very important and regard their own teaching to be effective to very effective. Taken in conjunction with the ratings given to Items 9 and 10 in Table 39, which concern syllabus revision and reconstruction, the results tend to suggest satisfaction among the majority of teachers with the emphasis placed on the subject, with the effectiveness of their teaching, and with the syllabus as a whole.

In the light of this general level of satisfaction it is interesting to note that of the five aims stated in the syllabus (Table 22) only two were seen to be achieved at just above a moderately successful level. The other aims were given ratings at just above a slightly successful level. This might reflect difficulty in implementing a teaching program for the attainment of the various aims or it might indicate how relevant teachers see the various aims to be. In addition to other possible interpretations the ratings might be influenced by how clearly the aims are stated or how well their implications are understood. Nevertheless, teachers' views on the relative extent to which aims are achieved is an important index of how they see both the syllabus and the implementation process.

In addition, marked differences are evident among the five content areas in terms of the amount of the interest they arouse in children and difficulty which teachers experience in teaching them. The results in Tables 24 to 27 and in Table 32 indicate that only the content area "Living Things" is seen to be least difficult to teach. Also, with the exception of "Conservation", the other three areas comprising "Energy", "Earth in Space" and "Surface of Earth" are, seen to be relatively very difficult to teach. In addition both "Energy" and "Surface of Earth" were rated relatively uninteresting to children. Thus only one of the content areas of the syllabus is, on the whole, seen by teachers to be both interesting to children and relatively easy to teach. The general satisfaction with the syllabus indicated by earlier results needs to be qualified. Since only one content area appears to receive a consistently favourable rating, and of the five aims only two are seen to be achieved reasonably successfully, it might be concluded that, in most of the content areas some problems exist and that perhaps some clarification and/or reassessment of the aims is warranted.

In relatively recent times, support has been given to the science syllabus in the form of the supply of resource material and apparatus. Because "Living Things" was rated consistently high for resource material availability and for adequacy of apparatus, one

might be led to conclude that the favourable rating this area for both "interest" and "ease of teaching" was related directly to resource material availability and to supply of apparatus. It might be suggested therefore, that an appropriate form of support is to reinforce these aspects in all areas.

While there is no doubt that resource material and apparatus are important, the conclusion that, at this time, additional supplies would influence substantially teachers' ratings for "ease of teaching" and "pupil interest" does not appear warranted. For example, the content area "Conservation" was rated second to "Living Things" in terms of "ease of teaching" but last in terms of resource material availability. Also, whereas "Energy" was seen to be most difficult to teach it was rated third in terms of resource material availability. It would seem therefore that the relationship between resource material availability and teachers' perceptions of ease of teaching is not very great. Furthermore, the content area "Energy" was rated second lowest for "interest", lowest for "ease of teaching", and first on the criteria of apparatus availability. It would seem that apparatus availability also bears little relationship to "ease of teaching" or for that matter "interest aroused in children".

On the other hand, many saw that notes or hints and tips for science teaching would be valuable. Thus, it would seem that the "how-to-teach" aspect is of greater importance at the present than is either additional resource material or additional apparatus. This view seems to be supported by the results in Tables 37 and 38 which show that about half the teachers in each case indicate a relatively great need for guidance in experimental techniques and assistance in the selection of experiments. Both of these are of a "how-to-teach" nature.

Some guidelines as to the form that this "how-to-teach" kind of support might take, is provided from the results which show what teachers see to be key priorities. From Table 39, based on the magnitude of the means, the order of priority for various forms of support is: hints and tips on science teaching; in-service workshops; lists of science resources; information statements on new science teaching techniques; and curriculum papers on aspects of science teaching. Certainly, on this criteria, the least wanted form of support as far as teachers are concerned, is syllabus revision or reconstruction. It is also of interest, that, of all the forms of support, that rated third last was the provision of science advisory teachers.

It might be noted however, that this order for priorities is based on the relative magnitudes of the item means. In many cases the range of opinions, indicated by the standard deviations, is of as much, if not more, interest than are the means. This is particularly true when it comes to opinions such as those concerning priorities for providing teachers with assistance or support. One method for taking account of ranges of opinion is to group people on the basis of similarity of opinions. By doing this sub-groups characterised by a relatively high degree of within-group consensus, can be obtained.

The results of the clustering process, which identified empirically the least number of significantly different sub-groups, based on importance for various kinds of assistance, are shown in Section 3. Three groups are derived. The profiles of these groups show how the relative importance of the various kinds of support differs.

The differences are exemplified when we look at the profiles for each group and the proportion of teachers which each of these groups contain. For 56% of the teachers key priorities are, in order: hints and tips on science teaching, in-service science workshops, lists of science resources, information statements on new science techniques, and curriculum papers on aspects of science teaching. For 24% of teachers, on the other hand, all forms of assistance with the exception of lists of resources, and syllabus change

are seen to be important. The other groups comprising 20% of teachers placed high importance on only four areas. For this minority group the key priorities in order were: syllabus revision, syllabus reconstruction, hints and tips on science teaching, and in-service workshops. Thus despite the very low overall mean ratings given to the items concerning syllabus change, at least 20% see this as a top-priority issue.

Thus if there is a concern for catering for individual differences in teachers' preferences for the form assistance should take, the group profiles provide an indication of the best way to make a compromise between a general approach for all and the impossibility of satisfying each teacher's idiosyncratic requirements to the full. The profiles also suggest the extent to which teachers would differ in their preferences for taking advantage of the various forms of support if these were offered on a voluntary basis.

Other results give some indication about the kind of teaching which takes place. Table 23 showed the relative degree of emphases teachers placed on various teaching activities and techniques commonly used in teaching science in the primary school. In Section 2, principal axis factor analysis was used to provide an indication of the basic structure which underlies the emphasis ratings for the various activities and techniques. The basic teaching strategies identified from this analysis were: apparatus usage and experimentation; pupil involvement and problem-solving; oral work and oral evaluation; outside, external, non-teacher directed activity; television and media instruction; and written work and written evaluation.

An indication of the patterns with which various sub-groups of teachers employed these strategies was obtained empirically from the cluster analyses of factor scores and are shown in detail in Section 2. The profile of each of the five derived groups shows the predominant style for the group members. Two common styles are indicated by the profiles of Groups 1 and 2 which together comprise 64.4% of the teachers sampled. Each of the other three minority groups have a distinctive profile or teaching style. The main difference between the teaching styles of the two major groups is in the amount of emphasis given to three strategies – pupil involvement and problem-solving; oral work and oral evaluation; and on television and media instruction. While no judgements can be made at this stage concerning the effectiveness of particular styles, it is possible that different styles might influence pupil outcomes. Even on a priori grounds these results provide a great deal of scope for speculation on how the syllabus is being implemented. To see relationships between patterns of emphasis might well be a fertile area for research.

Finally, the results provide a reasonably comprehensive picture, from the teachers' viewpoint, of various key features of science teaching in the region. Some of the results do no more than give basic information, others suggest guidelines for action. Most provide impetus for serious thought about science and science-teaching in primary schools.

APPENDIX 1: INSTRUMENT

SCIENCE

IN THE PRIMARY SCHOOL

– A QUESTIONNAIRE FOR TEACHERS

Research and Curriculum Branch Department of Education

One of the tasks of the Primary Science Syllabus Committee is to make recommendations to the Primary Curriculum Committee regarding the Primary Science Syllabus and its implementation in Queensland.

This questionnaire is designed to provide information to the Committee about the current status of science teaching in Queensland primary schools, and teachers' perceptions of the 1966 Science Syllabus.

At this stage of the year, many teachers will have completed a full year of science teaching with their grades.

It is desirable that any attempt to collect information on science teaching and teachers' impressions of the 1966 Science Syllabus should take advantage of this experience. For this reason it has been decided to administer the questionnaire now, rather than early in the new year.

As it is hoped to make information from the questionnaire available to the Committee early in 1974, it would be appreciated if the questionnaire could be returned before the end of the school year.

The questionnaire has two parts.

Part 1 is concerned with the context in which science is taught. It seeks information about schools and teachers.

Part 2 is concerned with how science is taught and your views of the syllabus, its implementation and any difficulties you may have encountered.

When answering the questionnaire, please give your own personal opinions. There is no right answer to any question, in the sense of a particular answer being the most desirable or appropriate. Obviously, different teachers teach science in different ways and have different opinions concerning many aspects of the syllabus and its implementation. We would like to know what different ways of teaching are used and what these opinions are.

Please indicate your response by placing a tick (✓) in the appopriate box, or by providing the information requested.

No attempt will be made to identify the answers of any individual teacher.

The questionnaire should take approximately 30 minutes to complete. When you have completed it, please return it to your Principal as soon as possible.

Your assistance in the collection of this information will be greatly appreciated.

PART 1: THE CONTEXT IN WHICH SCIENCE IS TAUGHT

1. How many teachers are there at your school?
   - 1 teacher ☐
   - 2 teachers ☐
   - 3 teachers ☐
   - 4–10 teachers ☐
   - 11–20 teachers ☐
   - more than 20 teachers ☐

2. Where is your school located?
   - the metropolitan area ☐
   - a provincial city (population greater than 10 000) ☐
   - a provincial city (population 1000 to 10 000) ☐
   - a small town or a district ☐
   - other (Please specify) ☐

   _____ . . .

3. How is your classroom best described?
   - a self contained classroom ☐
   - a multiple area classroom ☐
   - other (Please specify) ☐

   _____ . . .

4. What grade(s) are you teaching this year?_____

5. How were children assigned to your class?
   - on the basis of ability ☐
   - heterogeneously ☐
   - other (Please specify) ☐

   _____ . . .

6. Overall, how would you describe the ability of the children in your class?
   - High ability ☐
   - Moderate ability ☐
   - Low ability ☐

7. Are children grouped in any special way for science teaching? (e.g. ability grouping across classes)
   - Yes ☐
   - No ☐

   If yes, please describe briefly_____ . . .

8. How is science teaching organised in your school? [If it is necessary for you to tick more than one option, please indicate the grade level(s) associated with each.]
   - each teacher teaching his or her own class which comprises one grade ☐
   - each teacher teaching his or her own class which comprises more than one grade ☐
   - a single teacher teaching all science for a particular grade ☐
   - a teaching team approach ☐
   - other (Please specify)_____ . . .

9. Does your school have a room specially arranged for science teaching?
   - Yes ☐
   - No ☐

10. Are the children in your class involved in Agricultural Project Club activities?
    - Yes ☐
    - No ☐

    If yes, what activities are being undertaken

    _____ . . .

11. What qualifications do you have which would help you to teach science?
    - one or more Junior Science Subjects ☐
    - one or more Senior Science Subjects ☐
    - Teachers College Science Subjects
      - 1 year ☐
      - 2 years ☐
      - 3 years ☐
    - some University Science Subjects ☐
    - a University Major in Science ☐
    - a Science Degree or Degree Equivalent ☐
    - other (Please specify)_____ . . .

12. How long have you been teaching?
    - 0–3 years ☐
    - 4–5 years ☐
    - 6–10 years ☐
    - More than 10 years ☐

13. What is your sex?
    - Male ☐
    - Female ☐

14. How old are you?
    - Under 25 years ☐
    - 25-45 years ☐
    - over 45 years ☐

PART 2: SYLLABUS IMPLEMENTATION

15. How much time do you spend each week *teaching* science?

- none (you do not teach science) ☐
- less than ½ hour ☐
- ½ to 1½ hours ☐
- more than 1½ hours ☐

[IF YOU DO NOT TEACH SCIENCE, PROCEED DIRECTLY TO QUESTION 33. DO NOT ANSWER QUESTIONS 16 TO 32.1]

16. Approximately how much time do you devote each week to the *preparation* of science lessons?

- less than ½ hour ☐
- ½ to 1½ hours ☐
- more than 1½ hours ☐

17. Do you consider that you devot adequate time to preparation?

- Yes ☐
- No ☐

18. How closely do you follow the 1966 Science Syllabus in developing learning learning experiences for your class?

- Very closely ☐
- Moderately closely ☐
- Not at all (a different approach is used) ☐

19. How adequate is the suggested time of 1–1½ hours per week for science teaching in the primary school?

- Very adequate ☐
- Adequate ☐
- Inadequate ☐
- Very inadequate ☐

20. How important is it that Science is part of the Primary School Curriculum?

- Very important ☐
- Important ☐
- U-important ☐
- Very important ☐

21. How effective do you believe your science teaching to be?

- Very effective ☐
- Effective ☐
- Inaffective ☐
- Very ineffective ☐

22. The aims of the 1966 Science Syllabus are listed below. How successfullly have these aims been achieved with your class?

	Very successfully	Moderately successfully	Slightly successfully	Not at all
The stimulation and development of the child's natural curiosity and interest in the world around him.				
The development of skills and attitudes involved in using the methods of science to reach new knowledge				
The development of an understanding of the generalizations of science.				
The development of a sense of responsibility for the conservation of natural resources.				
The development of an understanding of the essential nature of science and an appreciation of its romance, power, limitations and impact on our way of life.				

23. Listed below are some activities and teaching techniques you might use in your teaching of science. Some of these will be used extensively in your teaching while others will be used in only a small proportion of your teaching program if at all. Indicate to what extent you employ each of the following:

	Very Great Extent	Great Extent	Little Extent	Very Little Extent	Not at all
Pupils watch T.V. lessons					
T.V. lessons are the basis for other science lessons					
Teacher demonstrates experiments					
Pupils demonstrate experiments					
Pupils perform their own experiments and handle apparatus					
Pupils spend science periods in library					
Pupils have science lessons outside the classroom or library e.g. in school grounds, at swimming pool					
Pupils go on organized excursions					
Pupils record notes in a science book					
Pupils undertake group science projects					
Each pupil undertakes his own science project					
Pupils discuss topics or problems in small groups.					
Pupils investigate problems suggested by the teacher					

25. How appropriate is the scientific apparatus available to you in your school for science teaching?

- Very appropriate ☐
- Appropriate ☐
- Inappropriate ☐
- Very appropriate ☐

If you indicated that the scientific apparatus is inappropriate (or very inappropriate) list below the types of apparatus you would like to have available

_____ ...

26. How adequate is the rate of issue of scientific apparatus to your school?

- Very adequate ☐
- Adequate ☐
- Inadequate ☐
- Very inadequate ☐

If you indicated that the rate of issue of scientific apparatus is inadequate (or very inadequate) list below the rate of issue you would like

_____ ...

27. How adequate are the teacher resource materials (e.g. reference books) available to you for science teaching?

- Very adequate ☐
- Adequate ☐
- Inadequate ☐
- Very inadequate ☐

If you indicated that the teacher resource materials available are inadequate (or very inadequate) list below the types of materials you would like to have available.

_____ ...

28. How adequate are the pupil resource materials (e.g. books, kits) available to you for science teaching?

- Very adequate ☐
- Adequate ☐
- Inadequate ☐
- Very inadequate ☐

If you indicated that the pupil resource materials available are inadequate (or very inadequate) list below the types of materials you would like to have available.

_____ ...

29. For the statements below, indicate how great you believe your need to be

	Extent of Need				
	Very Great	Great	Little	Very Little	None at all
A need for guidance in techniques for conducint experiments					
A need for assistance in the selection of experiments to be performed					

30. In recent years a variety of resource materials for the teaching of science have been issued to primary schools (e.g. science trolleys, teacher reference books, microscopes). In Column 1 below, list those you have found to be *most useful.*
In Column 2, list those you have found to be *least useful.*

Column 1 *most useful*	Column 2 *least useful*
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

31. In your science teaching you may have found other resource materials (not supplied by the Department) to be of great value. If you have used any such materials, please list the three most valuable (in order of importance)

_____ ...

32. How important is each of the

	Very important	Important	Unimportant	Very Unimportant
Inservice science workshops				
Inservice seminars				
Information statements on new science teaching techniques				
Resource Reviews of science materials (e.g. books)				
Curriculum Papers on aspects of science teaching in the primary school				
Lists of science resources				
Hints and tips for science teaching				
Science advisory teachers				
A revision of the present syllabus				
The construction of a new syllabus				

33. How much interest do you personally have in science and scientific activities.

- Very great interest
- Great interest
- Little interest
- Very little interest
- No interest at all

34. TO BE ANSWERED ONLY BY THOSE TEACHERS WHO DO NOT TEACH SCIENCE.

Please outline the arrangements made for teaching science to your class.

_____ ...